UNIVERSITY OF GONDAR

COLLEGE OF VETERINARY MEDICINE AND ANIMAL SCIENCES

MANGE MITES INFESTATION IN SMALL RUMINANTS AND CONTROL PRACTICE IN SELECED DISTRICTS OF WAG_HIMRA ZONE AMAHARA REGION, ETHIOPIA

By

ADANE AGEGNNEHU W/KIDANE

A Thesis Submitted to the Faculty of Veterinary Medicine, University of Gondar in Partial Fulfiment of the Requirement for the Degree of Master of Veterinary Parasitology

JUNE, 2017

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LIST OF ABBREVIATIONS

CSA	Central Statistical Agency
CI	Confidence Interval
ECBP	Engineering capacity building program.
ESGPIP	Ethiopian sheep and goat productivity improvement program.
KOH	Potassium hydroxide.
SNNPR	Southern Nation, Nationalities and people Region.
MOARD	Ministry of agriculture and rural development.
OR	Odds Ratio.
UNIDO	United nation industrial development organization.

ABSTRACT

A cross sectional study was conducted from December 2016 to April 2017 to determine the prevalence of mange mites infestation in small ruminants (sheep and goats) and identify the potential risk factors and major species of mites in selected three agro-ecological zones of Wag-Himra zone, Ethiopia. In addition, a questionnaire survey was conducted to assess the awareness and control practices by livestock owners on mange mite's infestation in the study areas. Simple random sampling technique was used, to select study animals from the flock of small ruminants. From a total of 384 sheep (n=120) and goats (n=264), skin scraps were collected. From the total collected samples 105 (27.33%) were positive for mange mites infestation. *Sarcoptes scabiei* (*S. scabiei*) was the only mange mite species identified. The prevalence of *S. scabiei* among species was 33.3 % (n=40) in sheep and 24.6% (n=65) in goats. The current finding revealed that species, age, did not show statistical significant (P>0.05) association in prevalence of S.scabiei infestation. On the other hand, the prevalence of *S. scabiei* infestation on small ruminants was statistically significant (P<0.031) in the three agro-ecological zones. The pathological lesions caused by *S. scabiei* were observed on the face, head, ear and tail regions and crusts formation and loss of hair. There was no statistical significant deference (p>0.05) in the prevalence of *S.scabiei* infestation between female and male, poor body conditioned in both host species in the study animals. The result of the questionnaire survey indicated that Shoats were the main species of animals owned by the farmers and mange was known to be considered as an important disease by small ruminant holders. From the interviewed livestock holders, 132(86.27%) respondents explained that they use modern acaricides for the treatment of mange. In addition, 149(97.38) respondents were participated on control program for mange mite infestation launched by the government. In conclusion, this study demonstrated high prevalence of *S. scabiei* in sheep and goats of the study area, and revealed that *Sarcoptes* to be the only mite in both sheep and goats, hence requires immediate attention and control interventions.

Keywords: *sheep, goats, Sarcoptes scabiei, risk factors, prevalence, Wag-Himra zone*.

1. INTRODUCTION

Ethiopia has the largest livestock population in Africa which provides draught power, milk, meat, fiber, fuel and fertilizer. Livestock plays an important role in providing export commodities, such as live animals, hides and skins to earn foreign exchanges to the country (CSA, 2013). Small ruminants (goats and sheep) represent important sources of protein in the world, supplying a good percentage of the daily meat and milk products in urban and rural areas. In Ethiopia, small ruminants are important contributors to the economy of the country; providing about 90% of live animals/meat (CSA 2013).

The small ruminant's population in Ethiopia are estimated to be 25.5 million sheep and 24.06 million goats (CSA, 2013). They are also important contributors to food production; providing 25% of meat and 14% of milk for domestic consumption (Metaferia *et al.,* 2011). Further, their waste materials are also very important in agriculture fields as organic fertilizer. It is estimated that the country could collect 3.7 million cattle hides, 8.4 million sheep skin and 7.7 million goat skin.

The sheep and goat skins are well known for their quality. The goat skins in particular have got international acceptance. Both goat and sheep skins are preferred for leather garments and gloves manufacturing in addition to being used for shoe upper. Currently, there are about 26 fully functional tannery industries in Ethiopia. The tanneries have capability of soaking about 153,650 sheep and goat skin and 9,725 per day but most tanneries working below their capacity (UNIDO, 2012).

The development of leather industry requires great quantity of raw materials of various origins, the principal source of raw material is livestock industry hence Ethiopia has the considerable resource potential for the leather industry. In 2010/11 leather industry product exported from Ethiopia enabled to earn 104 million United States dollar (USD) (UNIDO, 2012).

Reports have indicated that skin utilization is estimated to be 75% for goat and 97% sheep skin, with expected off-take rate of 33% and 35% for sheep and goat, respectively (Tadesse and Mebrahitu,

2010; Tesfaheywet and Misgana, (2012). Ethiopia is more popular in raw hides and skins exporter than leather and Product (Mulat, 2015). However; raw skin production from sheep and goats in Ethiopia has faced a serious challenges since skins are downgraded and rejected as a result of various ante-mortem and post-mortem defects contributed by poor animal husbandry and nutrition, skin diseases, improper slaughter and flaying operations (Bisrat, 2013) and improper practices of curing, collection, transportation and storage (Zembaba *et al.*, 2013).

Ectoparasites such as mites, ticks, lice and fleas affect large number of sheep and goats in Ethiopia. They are one of the major hindrances to the productivity of small ruminants in the country. Ectoparasites cause a wide range of health problems including mechanical tissue damage, irritation, inflammation, hypersensitivity, abscesses and predispose to myiasis and dermatophilosis. Infestations increase susceptibility to other diseases and create sites for secondary invasion by pathogenic organisms and reduced productivity (Mersha *et al.*, 2010).

Mange mites have been reported as one of the most prevalent and widely distributed skin disease in Ethiopia by degrading skin quality (Yacob, 2013; Ahmed *et al*., 2015). Mange mites result in economic loss to the tanning industry and the country (Yacob, 2013). In Amhara Region mange has been the great threat for the production of small ruminants (Amsalu *et al.*, 2000).

Considering skin disease effects on the socio-economy of the country, the national and regional states for small ruminant skin disease (due to parasitic origin) control programs had been designed by the Ministry of Agriculture and Rural development of Ethiopia in 2005 and launched in Tigray, Amhara, Oromia and Afar Regional States (MoARD, 2005; Klee man, 2008). To achieve this mission various types of ectoparacitides like diazinon (0.06%) were used.

Despite such national and regional efforts and emphasis given to the control programs against parasitic skin diseases, reports have shown that the problem seems to be still alarming (Seid *et al.*, 2014; Yacob, 2014; Bedada *et al*., 2015; Yasine *et al*., 2015). In addition, farmers have been complaint on the effectiveness of acaricidal chemicals used in the control program. Therefore, the objectives of this study was**:**

General objectives:

- To determine the prevalence of mange mite infestation and assess their control practices on small ruminants in different agro-climatic conditions in the study area.

Specific objectives:

- To estimate the prevalence of mange mites infestation in small ruminants.
- Identify species of mites in the study area.
- To assess the risk factors associated with the occurrence of mange in the study area.
- To know the level of awareness of sheep and goat owners about the disease and its control practices.

2. LITERATURE REVIEW

2.1. Introduction to manage mites

Mange is a contagious skin disease, characterized by a variety of clinical signs depending on species of mites involved (Tesfaheywet and Magana, 2012). In general, mange results in crusty, pruritic dermatitis and hair/feather losses. It can be caused by a variety of parasitic mites which burrow in or living on the skin; where they feed on blood, skin debris or sebaceous secretions, which they ingest by puncturing the skin, scavenging from the skin surface or imbibe from epidermal lesions. Most ectoparasitic mites spend their entire lives in contact with the host (Wall and Shearer, 1997).

Mange is an important skin disease which can affect a variety of animals including cattle, goats, sheep, horses, pigs, rabbits, and dogs. In Ethiopia, various types of mites have been recorded in small ruminant population with variable rate (Mersha *et al*., 2010). Moreover, some species (example Sarcoptes species) have zoonotic importance since they able to infect human beings (Kuhn *et al.,* 2008; Salifou *et al.,* 2013). Different studies have revealed that both sheep and goats can be infested with one or more ectoparasite (Asmare et *al*., 2012; Tesfaheywet and Muluneh, 2012; Tewodros *et al*., 2012).

2.2. Etiology of mange

In small ruminants, five species of parasitic mites have been recorded to cause mange: Sarcoptes, Psoroptes, Demodex, Chorioptes and Psorergates species. However, the former four types of mites predominate in the world and each has morphologically distinct features one from the other (Nelson, 2009; Asmare *et al*., 2012). All have high degree of host specificity (Tesfaheywet and Magana, 2012). Mites can be divided as burrowing mites (*Sarcoptes* and *Demodex* species) and the non-burrowing mites (*Psoroptes* and *Chorioptes* species) (Marimuthu *et al*., 2015).

2.3. Epidemiology

In Ethiopia, various types of mites have been recorded in small ruminant population with variable rate (Mersha *et al*., 2010). Adult mites do not usually survive more than two weeks away from the host, but in optimum conditions, they may remain alive for up to three weeks (Radostits *et al*., 1994). Four main types of mange mite species (*Sarcoptes, Psoroptes, Demodex* and *Chorioptes* species (Asmare *et al.*, 2012) have been recorded in Ethiopia. Sheep and goat mange has been reported to occur in various areas of Ethiopia at a rate ranging from mite (7%) (Tewodros *et al.*, 2012) to 11.7% (Tesfaheywet and Lemma, 2012; Amsalu et al., 2000; Mulugeta *et al.*, 2010).

2.3.1. Sarcoptes mange

Sarcoptes scabiei var. caprae and *Sarcoptes scabiei var. ovis* have a wide geographic distribution in goat and sheep rearing in arid and semi-arid areas of Ethiopia (Mulugeta *et al*., 2010; Asnake *et al.*, 2013). Sarcoptes is the most prevalent species in Ethiopian sheep and goat, and psoroptic mange and demodectic mange have been also reported by different authors (Worku, 2002; Ahmed, 2015). Sarcoptes and Demodex mainly affect sheep and goats (Tewodros *et al.*, 2012; Yifat*et al*., 2013).

Age and body condition score of the animals, season and immunity status have been identified as important factors for evaluation of the mange mites infestation (Asmare *et al*., 2012). Therefore, authors reported that kids and older animals, poor body scored and malnutrition animals are more susceptible to various species of mite infestation (Sarkar *et al*., 2010).

Sarcoptic mange occurs in all species of animal and is caused by mite Sarcoptes scabiei that has a number of host adapted sub species, distinguished by presence or absence of patches of dorsal and / or ventral spine, that affect different hosts but this host specificity is not complete and transference from one host species to another can occur (Radostits *et al.,* 1994). *Sarcoptes* mites are economically the most important cause of mange in goats but rare in sheep. Sarcoptic mange in sheep and goats is caused by *Sarcoptic scabeis var ovis* and *Sarcoptes scabeis var Capri* respectively (Okoh, 1982; Olubunmi, 1995). Sarcoptic mites are highly specialized for life with in

the skin. Female mites burrow into the skin and lay eggs in tunnels they made. Mating takes place on the surface of the skin (Sewell and Brockelsby, 1990).

The life cycle from egg to egg laying female may take 10-14 days (Radostits *et al*., 1994). The feeding activity of Sarcoptes causes intense itching and scratching due to marked irritation, which causes self-inflicted lesions that aggravates the conditions (Jackson, 1991). Sarcoptes mange usually start on relatively hairless part of the skin and may latter generalize (Bowman and Lynn, 1999). The course of Sarcoptic mange is rather more acute than the other forms of mange and may involve the entire body surface in a short time (Radostits *et al.,* 1994).

Sarcoptic mange is highly contagious and the spread of *S. scabiei* is usually by close physical contact. As a result single cases are rarely seen in groups of animals kept together. Infestation may also occur by indirect transfer, since the mites have been shown to be capable of surviving off the host for short periods. The length of time that *S. scabiei* can survive off the host depends on environmental conditions but may be between 2 and 3 weeks (Wall and Shearer, 1997).Sarcoptic mange was noticed throughout the year but the incidence was higher during the wet cold months where the moistness and temperature is optimum condition for mites' development (Olubunmi, 1995).

2.3.2. Psoroptic Mange

Psoroptic mange, known as sheep scab, is highly contagious disease of sheep and goats. It is caused by the mite, *Psoroptes ovis* in sheep and *Psoroptes cuniculi* in goats. The mite migrates to all part of the skin and prefers areas covered by wool or hair. The whole life cycles completed in 3 weeks (Soulsby, 1982). Infestation by these mites is always superficial on the epidermis, but the piercing of the skin by the mites lead to exudation and exfoliation, causing scabs to form (Sewell and Brockelsby, 1990). In sheep, the cutaneous lesions may occur on any part of the body, but characteristically in badly affected sheep, they are most obvious on sides. In goats, lesions can vary from a dry crusty scab on the external ear canal with no clinical signs to severe lesions covering much part of the body and causing death (Jackson, 1991).

Sheep scab can affect sheep of all ages but may be particularly severe in young lambs. Mites are usually more active in winter and the oviposition rate is higher at lower temperatures. In summer the disease progress more slowly, lesions are not obvious and can be missed. The disease can become latent in summer, apparently disappearing, with mites taking refuge in protected sites (Wall and Shearer, 1997). Some observers suggest that infra-orbital, in guinalpouches, scrotum, under tail, ears, inter digital pouches, perineum, and skin folds are foci for mites and serve as potential dry season hiding places where the mites tend to migrate to the general body surface with the onset of cold season (Roberts and Meleney, 1971).

The short life cycle can contribute to a very rapid buildup of *P. ovis* populations. Scab mites are spread by direct contact and can survive for a period of up to 10 – 14 days off their hosts(depending on the environmental conditions), allowing clean animals to become infested from contaminated housing (Wall and Shearer, 1997).

2.3.3. Chorioptic Mange

Chorioptic mange (tail, leg, scrotum mange) those on cattle, horse, and goats and sheep are now considered to be one species; *Chorioptic bovis* (Radostits *et al*., 1994). The life cycle of *Chorioptic bovis* is similar to that of *Psoroptes* and is completed in 3 weeks and transmissions by direct contact and contaminated materials, but Chorioptes does not survive off the host for more than a few days (Peter, 1995). In goats, lesions of these conditions are usually confined to lower part of the leg and crusty lesions may be found behind fetlock of all four limbs (Jackson, 1990). In sheep, it affects the scrotum and may cause decrease in fertility (Radostits *et al.*, 1994).

2.3.4. Demodectic Mange

Demodectic mange mites of *Demodex species* infest hair follicles of all species of domestic animals. *Demodex* live as commensals, embedded head down hair follicle, and sebaceous and Meibomian glands of the skin where they spend their entire lives. For the most part they are nonpathogenic and

form a normal part of the skin fauna. Species of *Demodex* are unable to survive off their hosts (Wall and Shearer, 1997).

The disease cause little concern. But in cattle, there may be significant damage to the hide and rarely death due to gross secondary bacterial invasion. The disease may also be severe in goats. The important signs of the disease in goats are the appearance of small nodules and pustules which may develop into larger abscesses from which large number of *Demodex* mites may be expressed (Jackson, 1991). The disease spreads slowly and transfer of mite is through contact probably early in life (Radostits *et al.*, 1994).

2.3.5. Pathogenesis and clinical signs

The transmission of mange mite from host to host is primarily by physical contact capable of migrating and inert materials such as bedding and grooming tools can act as a carrier These mites tunnel through epidermis and feed on tissue fluids (DACAE, 2006).

High temperature, humidity and sunlight favor mange mite infestations (Pangui, 1994).Problems with mite infestations and dramatic increases in mite populations occur more commonly in animals in poor condition and more often seen at the end of winter or in early spring. Some forms of mange such as demodectic mange, are the result of underlying diseases or immune suppression (Wall an Shearer, 1997). The disease affects all age groups and runs amore chronic course in adults than younger animals. According to Wall and Shearer (1997), the effects of mite infestations are:

- Direct epidermal damage leading to inflammation; this result in skin erythema, pruritus, scale formation, lichenification(thickening) and crust formation(inflammatory exudates) formation;
- The production of cutaneous hypersensitivity (especially type 1 hypersensitivity).
- Loss of blood or other tissue fluid.
- Mechanical or biological transmission of pathogens.

The clinical signs of erythema, pruritus and scale or crust formation are due to the inflammatory response of the skin and resulting excoriation. This response is stimulated by feeding, burrowing or

the production of antigenic material by the mite (Wall and Shearer, 1997).Mange cases due to Sarcoptes and Psoroptes are often fatal. The mortality rate is higher inland in poor condition animals (Sewell and Brockels by, 1990; Olubumni, 1995). Death may be due to dehydration, a direct result of the feeding of huge number of mites, inability to move and feed due to severe lesions on the face, muzzle and on the joints or to secondary cases such as pneumonia or bacterial septicemia introduced through self-inflicted bite and scratch wounds (Roberts *et al.*, 1971).

In infections, which do not end fatally, a marked regression of lesions, with healing of the skin and re-growth of the wool or hair occurs during dry season. Exposure of lesion and mite to direct sunlight and desiccation may reduce the survival potential of mite populations. The major species that cause mange in small ruminants belongs to the four genera of mite, namely *Sarcoptes, Psoroptes, Chorioptes* and *Demodex.*

Sarcoptic mange also known as scabeis is caused by Sarcoptes scabiei vary caprae which burrows up to 2 cm deep under the skin around the head and neck region to suck lymph, feed on the young epidermal cells and lay eggs 3 to 4 times a day and up to fifty times in its lifetime (Nelson, 2009). Goats affected with sarcoptic mange showed grossly crust formation and pruritic skin lesions on ventral abdomen, chest, limbs, forehead, neck region and shoulder with extensive alopecia, severe erythema and presence of adult mites and their eggs (Mersha *et al.,* 2010; Oludunsin and Ayinde, 2015) but in sheep, skin lesions due to Sarcoptes species have been determined to be less severe and most sheep can develop pruritic lesions on the head (Mersha *et al.,* 2010).

Microscopic lesions: The epidermal layer of the skin of sheep and goats affected by sarcoptic mange may develop hyperkeratosis and mildly hyperplastic, resulting in prominent rete ridge formation (Mersha *et al.,* 2010). Similarly acanthosis, spongiosis, hyperkeratosis, mite containing epidermal tunnel, hematological and biochemical imbalance have also reported and confirmed before the onset of treatment in West African Dwarf goats (Oludunsin and Ayinde, 2015). Sarcoptic mange in the dermal layer may result in mild folliculitis, perifolliculitis, frunculosis and follicular keratosis. Moreover, inflammatory cells such as eosinophils and neutrophils can be infiltrated into the papillary and reticular layers of the dermis. Proliferation of connective tissue of the dermis is also reported by different authors (Mersha*et al.,* 2010).

Goats infested with Demodex species may have non-pruritic papules and nodules containing waxy materials stuffed with cigar-shaped organisms in the hair follicle and sebaceous gland of the host. Nodular and ulcerative lesions are also observed (Assfaw *et al*., 2015). Other less common gross lesions with demodicosis are alopecia and encrustation. The distribution of nodular skin lesions of sheep infested with Demodex species have been reported to be similar to that of the goats (Mersha *et al*., 2010). However, sheep are more prone than goats to demodectic mange (Zewdu, *et al*., 2015).

Microscopic skin lesions observed in sheep and goats affected by demodectic mange include epidermal hyperplasia and follicular pigmentary inconsistency, epidermal and follicular hyperkeratosis, degeneration and necrosis of follicular basal cells, and inflammation of the sebaceous glands. Aggregates of lymphocytes, macrophages, eosinophils and neutrophils can be observed in the dermis. Moreover, perifollicular pyogranulomas, lymphoplasmacytic perifolliculitis and frunculosis can be detected around the hair follicles (Mersha *et al*., 2012; Assfaw *et al.,* 2015).

Psoroptic mange in sheep can be characterized by generalized pruritic dermatitis with ragged and stained wool due to intense itching and scratching. The skin may also be covered with dry, gray crusts and scales, and devoid of wool (Mersha *et al*., 2010). The gross lesions due to *Psoroptes ovis* mostly appeared in the back, shoulder and tail region. *Psoroptes cuniculi* infestation in the goat grossly characterized by laceration of epidermis with a scar formation and the skin's loss of flexibility, toughness with sclerosis, fissuring and dryness (Ihsan, 2013), alopecia, dandruff, thickening and corrugation of skin (Sarkar *et al*., 2010).

Hides and skins account for 12-26% of the total share-value of export (Yacob *et al.,* 2008a; Tesfaheywet and Misgana, 2012; Amare *et al.,* 2013) in Ethiopia. Mange is among the major economically significant diseases of small ruminants and has been frequently reported from different parts of Ethiopia (Tefera and Abebe, 2007; Bersisa *et al*., 2012; Kebede *et al.,* 2012; Seid *et al.,* 2014; Yasine *et al.,* 2015; Zewdu *et al.,* 2015).). In Ethiopia 35 % of sheep and 56 % of goat skin rejections are attributed to ectoparasites. Due to this the country has lost a large amount of money as a result of direct rejection or costs incurred for defective skins processing (Yacob, 2013).

Mange mites also create financial burdens of diagnostic, therapeutic or preventive programs at flock, community and national levels (Hafeez *et al*, 2007). They also cause considerable welfare problems and economic losses to the smallholder producers through the death of exposed animals, increase susceptibility to other diseases, production (meat and milk) and reproduction losses, losses as a result of replacement, treatment and prevention cost, reduction of wool quality, lowering quality and rejection of skins (Yacob *et al.,* 2008a, b, c). Skin diseases also pose a major risk to the tanneries productivity and the country revenue as whole by causing skin quality deterioration (Tekle, 2009; Yassin *et al*., 2015). In addition, reports revealed that mange mite infection can result in hematological changes in affected animals (Hafeez *et al*, 2007)

2.3.6. Economic impacts

Hides and skins account for 12-26% of the total share-value of export (Yacob *et al*., 2008a; Tesfaheywet and Misgana, 2012; Amare *et al*., 2013) in Ethiopia. Mange is among the major economically significant diseases of small ruminants and has been frequently reported from different parts of Ethiopia (Tefera and Abebe, 2007; Bersisa *et al*., 2012; Kebede *et al*., 2012; Seid *et al.,* 2014; Yasine *et al.*, 2015; Zewdu *et al.,* 2015). In Ethiopia 35 % of sheep and 56 % of goat skin rejections are attributed to ectoparasites. Due to this the country has lost a large amount of money as a result of direct rejection or costs incurred for defective skins processing (Yacob, 2013).

2.3.7. Mange mite and skin quality in Ethiopia

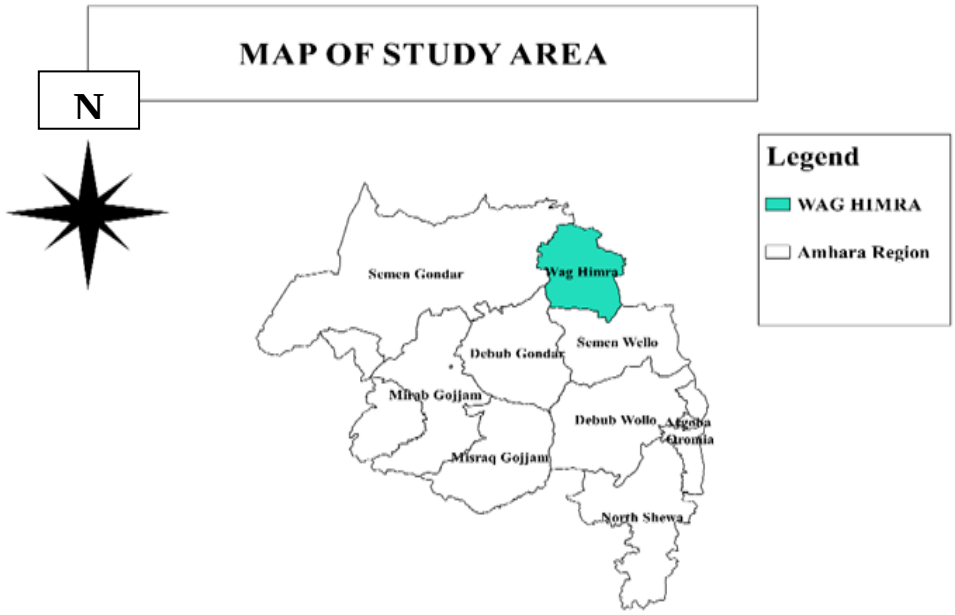
According to tanneries report, different skin diseases have caused about 50% processed skin rejection or downgrading because of unfit quality (Kassa *et al.,* 2012). Moreover, the national bank of Ethiopia pointed out that the cost of living with skin diseases (mainly ectoparasites) confirms about 3.6-4.2 million pieces of skin are graded as low quality where the country lost 14 mil US$ per annum. Mange mites are the most notorious ectoparasites of small ruminants and are responsible for great economic losses especially in Africa, including Ethiopia (Akomas *et al*., 2011). Mange is a widespread and most important ectoparasitic disease of animals, which may cause significant welfare problems and economic losses (Wall and Shearer, 1997; Mulat, 2015).

3. MATERIALS AND METHODS

3.1. Study area

This Study was conducted in the three selected districts (Gazgibla, Sekota and Ziquala) of Wag-Himra administrative zone, Amhara Regional State from November 2016 to April 2017 (Fig.1). Wag Himra zone which is located between 12^{o}C 23' and 13^{o}C 16' north longitudes and 38^{o}C 44' and 39^{0}C 21' east latitudes, in the eastern part of the country, far from 720 km north of Addis Ababa. Wag-Himra zone which represents in three agro-ecological zones namely Gazgibla (Highland), Sekota (midland), Ziquala (Low land).The annual rainfall, which is erratic in distribution, varies between 350 and 650mm.

The topography of Wag-Himra is rugged and mountainous. The agricultural production system is mixed livestock crop production system dominated by livestock production. The productivity of the land is low emanating from very low rainfall. The livestock population of the Wag-Himra comprises about 351,680 cattle, 156,918 sheep, 398,867 goats, 82,306 equines, 335, 398 poultry and 50,513bee hives (CSA, 2015/16).



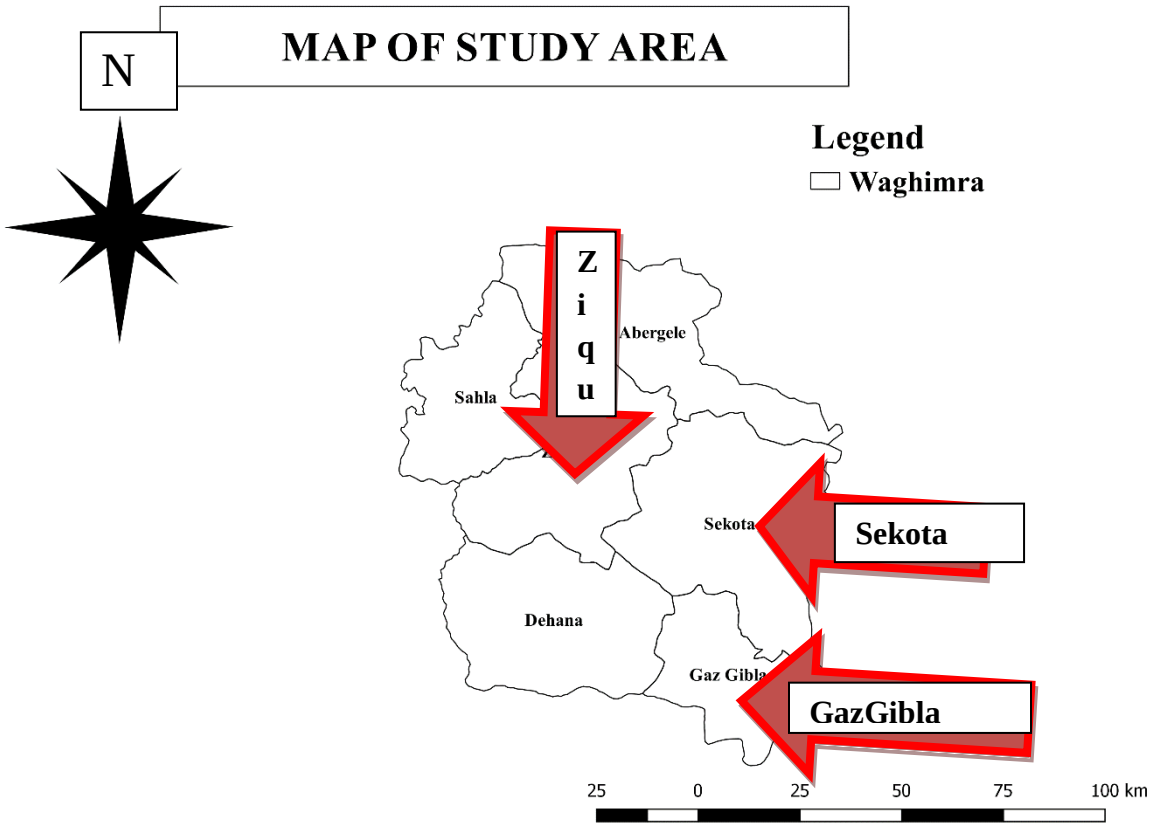


Figure 1: Map of Wag-Himra showing the study area.

3.2. Study animals

The study population were indigenous sheep and goats kept in small flocks and managed under traditional extensive farming system in different agro-climates. The study animals were classified sex, age and body condition. The age of study animals was grouped as young (up to 2 years) and adult (above 2 years) by considering the rate of eruption of teeth (Annexes 2).

Body condition score were categorized in to good and poor. Poor body condition score were assigned to sheep and goats that are extremely thin and with smooth and prominent spinous process. Good body condition score were given to those sheep and goats when there is only smooth, rounded spinous process and well covered transverse process (Annex 3). Age and body condition score was

determined by modifying the scoring system described by Gatenby (1991) and Steele (1996) for sheep and goats, respectively.

3.3. Study design and sample size determination

3.3.1. Cross sectional survey

A cross-sectional study was carried out by prepared questionnaires and parasitological examinations of samples taken from clinical cases encountered during field visits to determine the prevalence of mange mite infestation and their identification in the study area. Purposive and simple random sampling techniques were used to select districts based on their accessibility and agro ecological condition and PAs, respectively. Based on accessibility to transport and difference in geographical location three districts, namely Gazgibla, Sekota and Ziquala were purposely selected as study sites. The sample size for the study was determined as described by Thrusfied (2005), taking an estimated prevalence of 50% of with an accepted error of 5 % and confidence level of 95 %. Thus, for the present study 120 sheep and 264 goats from each agroecological zones (districts) were sampled.

$$n = \frac{Z^2 \times P_{exp} \times (1-P_{exp})}{d^2}$$

Where, n= the required sample size

$P_{exp=}$expected prevalence

$d^{2=}$desired absolute precision (5%)

Z= the Z (norma value for a given confidence level (e.g.1.96 for95%).

3.4. Methods of data collection

3.4.1. Questionnaire

Semi-structured questionnaire format (Annex 1) were prepared and used to collect information about the general attitude of the individual sheep and goat owners and to assess preventive and control practices against mange mites and evaluate risk factors on the occurrence of the disease. Sheep and goat owners were selected from three Peasant Associations (PA's) as representatives of 9 PA's and 17 individuals for each were also included amounting the total of 153 individual farmers. The questionnaire was framed in such a way that farmers could give information that are recent and easy to recall, and it was filled directly by interviewing randomly selected sheep and goat owners from selected peasant associations. The important points included in questionnaire survey were purpose of keeping animals, species of animals (sheep, goats) affected by mange, affected age group (young, adults), seasonality of the disease (wet, dry), effect of the disease on live animals and skin sale and control practices (modern, traditional).

3.5. Parasitological Examination

Examination of skin scrapings is essential in the diagnosis of mange. In longstanding cases mites are often very few in number and extremely difficult to find and their absence from the skin scraping doesn't negate a diagnosis (Jackson, 1991). Multiple sites should be scrapped to increase the likelihood of mite detection. Superficial skin scraping (epidermal surface examination) after removing coat hair by gentle clipping were used to identify surface mites while deep skin scraping (deep epidermal examination) until capill ary ooze occurs is useful in the diagnosis of burrowing and follicular mites such as Sarcoptes scabiei and Demodex spp.(Wall and Shearer, 1997).

A drop of the sediment was examined for the presence of mites on a glass slide with cover slip under a compound microscope using 10X, 40X or 100X magnifications after treatment with 10% Potassium hydroxide (KOH). Identification of parasite species was performed according to the method described by Wall and Shearer (2001) and Taylor et al. (2007). Any sample not showing the intact parasite or whole egg was considered to be negative.

3.6. Data Analysis

Raw data was carefully recorded and stored in Microsoft Excel database system used for data management. Statistical software package called SPSS for windows version17.0 was used for data analysis. Descriptive statistics, percentages and 95% confidence intervals were used to summarize the proportion of infested and non-infested animals. The effects of different environmental and host risk factors were analyzed by using logistic regration and Chi-square test. Statistical significance was set at $p \leq 0.05$.

4. RESULTS

4.1. Questionnaire survey

The result of the questionnaire survey indicated that all respondents 153 (100%) practice sheep and goats in the study area. The farmers in those study area keep their animals with the objectives of income generation 128 (85.66%) and home meat and milk consumption 25 (16.33%).

Interviewed respondents 109 (71.2%) replied that mange mite infection had great enforcements to sale their live sheep and goats and also affected 44(28.75%) of their sales of skins. Concerning the treatment of mange mites, the respondents indicated that mange mite was being treated more commonly by modern care of treatment 132 (86.27%) and some traditional treatments (ethino-medicines) 21 (13.72%) (Table1).

In addition, interviewed individual's explained that among external parasites, mange mites and lice infestation were the dominant ones that cause of skin diseases 136 (88.8%) and 17(11.11) respectively. And also goats were highly affected 130 (84.9%) than sheep's 23(15.03) by mange mites. Concerning the age groups and seasonality variation, 123 (80.39%) respondents were also explained that adults more affected than young animals. 131(85.62%) of the respondent's agreed that the infestation highly aggravated during the dry or after the rainy season, whereas about 22 (14.3 %) of the respondents replied mange is problem during the wet season (Table 1).

Concerning the control programme, 149 (97.3%) respondents were participate on control program that lunched by government but the remains 4(2.61%) respondents were not involved in any programme (Table1).

In addition to that the respondents explained transmission of mange mite was mainly by direct contact of sinks those animals on beading, grazing and watering places.

Table1: Summary of questionnaire survey (Annx1) on different points on small ruminants in the study area (N= 153)

Focal points	N0.respondants	Response (%)
Purpose of farming		
For income generation	128	83.66%
For home meat and milk consumption	25	16.33%
Affected species		
Goat	130	84.9%
Sheep	23	15.03%
Age group of animals affected		
Adult	123	80.39%
Young	30	19.6%
Seasonality of mange mites		
Dry season	131	85.62%
Wet season	22	14.37%
Effects of mange on		
sale	109	71.2%
live animal	44	28.75
Skin		
External parasite causing skin disease	136	88.88%
Mange mites	17	11.11%
lice		
Way of treatment	132	86.27% 21
Modern	21	13.72%
Traditional		
Participation of farmers in the control practice	149	97.38%
Yes		
No	4	2.61%

4.2. Species and characteristics of lesion of mange mites

On the present study the only isolated mange mite species affecting both sheep and goats was *S. scabiei* (Fig.2*)*. The lesion of *S. scabiei* in goats was found to be distributed around the face, head and tail and rarely around the neak and leg (Fig.1, B, and C). The lesion in this species was characterized by loss of hair, ragged wool and crust formations and cracking of the skin were observed on the infested animals. The lesion of *S. scabiei* on sheep was observed mostly around the head, face and ear areas and nodule formation was the characteristics of lesions (Fig.1, A).

(A) **(B)** **(C)**

Figure 2: Sheep (A) and Goat (B, C) infested with sarcoptic mange

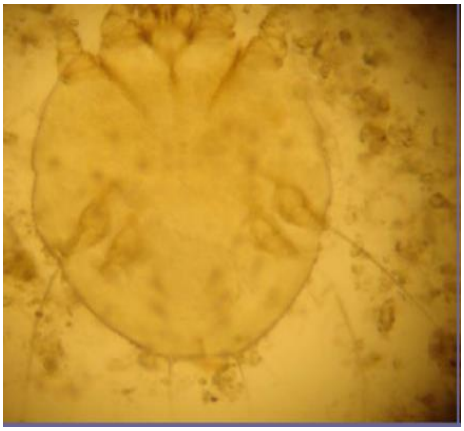


Figure 3: Ventral view of Sarcoptes mites

4.3. Demographic and Ecological characteristics of the study population

Out of 384 shoats included in this study, 105 (27.33%) were positive for mange mites. Since the only isolated mange mite species was S. *scabiei*, the overall percentage of *S.scabiei* was found 27.33%. Nearly two third (68.8%) of the shoats included in the study were goats since majority of the farmer rear goats in the study area. Similarly, three fourth (72.9%) were young and about 72.4% were female.

Based on field observation, higher number of shoats were recorded for having poor body condition (64.3%) and only about 35.7% were with good body condition. There were also scarce feed resources and sort of management problem during small ruminant production in the studied area.

Out of the total 384 study shoats' majority of animals the study animals were from different agro-ecology zone including highland, midland and lowland. Accordingly, animals from midland, highland and lowland at a rate of 44.8%, 21.4% and 33.9% respectively were included proportionate to the livestock population in the selected agro-ecology zone (Table 2).

Table 2: Demographic and ecological characteristics of study animals for mange prevalence and associated risk factors in Wag-Himra zone, Amhara region, North–West Ethiopia. (n = 384)

Risk Factors	**Frequency**	**Percentage (%)**
Species of animals		
Goat	264	68.8
Sheep	120	31.2
Age of animals		
Young	280	72.9
Adult	104	27.1
Sex of animals		
Female	278	72.4
Male	106	27.6
Body condition		
Poor	247	64.3
Good	137	35.7
Agro-ecology		
Midland	172	44.8
Highland	82	21.4
Lowland	130	33.9

4.4. Prevalence of mange mites

4.4.1. Prevalence of *S. scabiei* in sheep and goats

The overall prevalence of *S.scabiei* in the present study was found to be 27.33%. The distribution of prevalence of *S. scabiei* in sheep and goats population in this study area were 40 (33.33) % and 65(24.60%), respectively (Fig. 2). The difference in the prevalence between the two host species was not statistically significant (X^2=3.1519, p=0.076 (Table3)

Table 3: Overall prevalence of *S. scabiei* in sheep and goats

Spps of Mites	**Species of Animal**	**No.of Exam**	**No.of +ve**	**Prevalence (%)**	**95% CI**	**X^2 (p-value)**
Sarcoptes scabie	Sheep	120	40	33.33	0.24-0.41	3.1519 (0.076)
	Goat	264	65	24.60	0.19-0.29	
Total		384	105	27. 33		

4.4.2. Prevalence of *Sarcoptes scabiei* based on agroecology

The prevalence of mange mites in highland, midland and lowland was 44 %, 27.4 % and 21.0 % in sheep and 34.3 %, 26.4 % and 19.8 % in goats, respectively (Table 3). The overall prevalence of *Sarcoptes scabiei* infestations was significant varies (X^2=10.4288, P=0.005) among the three agroecological zones/ districts (Table 4).

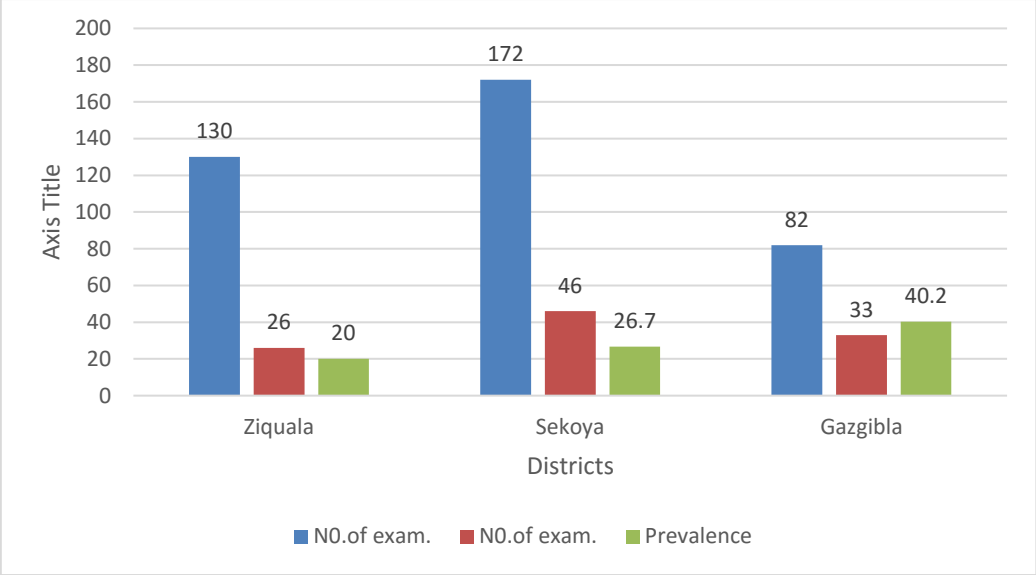


Figure 4: Prevalence of mange mites in selected districts/agro-ecologies.

Table 4: Prevalence of mites in sheep and goat in the three agro-ecological zone /district

Species of mite	Animal species	Agro-ecology	N0.exam.	N0.+ve	Prevl. (%)	X^2(P-value)
	Sheep	Lowland Ziquala)	19	4	21.0	(0.031)
Sarcoptes		Midland(Sekota)	51	14	27.4	
		Highland(Gazgibla)	50	22	44	
	Goat	Lowland(Ziquala)	111	22	19.8	
		Midland(Sekota)	121	32	26.4	
		Highland(Gazgibla)	32	11	34.4	
Total			384			

4.4.3. Prevalence of *Sarcoptes scabiei* based on sex and age categories

In this study both sex sheep and goats were infested with *Sarcoptes* mites with an overall prevalence of female sheep 32.55%, male 35.29 %, female goat 22.39% and male goat 30.55% mange mites were recorded (Table 5,6). Whereas in goats a higher prevalence rate was registered in females compared to the males (Table 6); however, the difference was not statistically significant ($p>0.05$).

The overall prevalence of mange mites in young and adult sheep was 34.28 % and 32.94 %, respectively (Table 5). The overall prevalence of *Sarcoptes* mite in young and adult goats was 30.43 % and 22.5 %, respectively. However, there was no statistically significant deference ($p>0.05$) between the prevalence age groups in both host species (Table 6).

4.4.4. Prevalence of mange mites based on body condition scores

An overall prevalence of 32.5% and 33.75 % mites in sheep and 28.8 % and 22.15% in goats was recorded in animals with good and poor body conditions, respectively (Table 5, 6). In both sheep and goats there was no statistical significant difference ($p > 0.05$).

Table 5: Prevalence of mange mite in sheep by different host related factors

Host related factor	**No.of exam**	**Prevl. %**	**95% CI**	**x2 (p-value)**
Sex				
Female	86	28(32.55)	0.22-0.42	
Male	34	12(35.29)	0.12-0.51	0.0821(0.774)
Age				
Adult	85	28(32.94)	0.22-0.42	
Young	35	12(34.28)	0.18-0.50	0.0202(0.887)
Body con.				
Poor	80	27(33.75)	0.10-0.21	
Good	40	13(32.5)	0.17-0.47	0.0188(0.891)
Total	120	40(10.41)		

Table 6: Prevalence of mange mite in goats by different host related factors

Host related factor	No.of exam	Prevl. %	95% CI	x^2 (p-value)
Sex				
Female	192	43(22.39)	0.22-0.42	
Male	72	22(30.55)	0.12-0.51	1.8785(0.170)
Age				
Adult	195	44(22.5)	0.22-0.42	
Young	69	21(30.43)	0.18-0.50	1.7012(0.192)
Body con.				
Poor	167	37(22.15)	0.10-0.21	
Good	97	28(28.8)	0.17-0.47	1.4887(0.222)
Total	264	65(16.92)		

4.4.5. Factors affecting the prevalence of with mange

In univariable logistic regression analysis; only agro-ecological variations was a factor yielded significant (P<0.031) association to the prevalence of *S. scabiei* infestation among the study population (Table7). In this study revealed that there was significant association (p<0.031) between *S. scabie* infestation and agro ecology. In the present study highland was 1.46 times more affected than those reared in midland and small ruminants reared in midland was (OR = 0.547) times less likely affected than those reared in lowland. The current finding revealed that species, age, sex, and body condition did not show statistical significant (P>0.05) association in prevalence of *S.scabiei* infestation.

Table 7: Univariable logistic regression analysis of factors associated with mange in Wag-Himra zone, Amhara region, North-East Ethiopia. (n = 384)

Risk factors	Categories	N0.of exam.	N0.of +ve	Prevalence (%)	Odds Ratio	95%CI(OR)	(p-value)
Species							
	Goat	264	65	24.60	1		
	Sheep	120	40	33.33	0.65	0.41-1.05	(0.08)
Age							
	Adult	280	72	25.7	1		
	Young	104	33	31.7	0.74	0.46-1.22	(0.24)
Sex							
	Female	278	71	25.50	1		
	Male	106	34	31.70	0.73	0.45-1.18	(0.20)
BCS							
	Poor	247	64	25.91	1		
	Good	137	41	29.92	0.82	0.52-1.30	(0.30)
Agro-ecology	M/land	247	46	18.6	1		
	Low land	130	26	20	0.54	0.31-0.95	**(**0.031**)**
	H/land	137	33	24.08	1.46	0.85-2.52	(0.17)

5. DISCUSSION

The questionnaire survey showed that all respondents in the study area keep their animals with the objectives of income generation and home meat and milk consumption. The result of the questionnaire survey indicated that all respondents 153 (100%) were kept sheep and goats in the study area. The farmers in those study area keep their animals with the objectives of income generation 128 (85.66%) and home meat and milk consumption 25 (16.33%).

Interviewed respondents 109 (71.2%) replied that mange mite infection had great enforcements to sale their live sheep and goats and also affected 44(28.75%) of their sales of skins. Concerning the treatment of mange mites, the respondents indicated that mange mite was being treated more commonly by modern care of treatment 132 (86.27%) and some traditional treatments (ethino-medicines) 21 (13.72%) (Table1).

In addition, interviewed individual's explained that among external parasites, mange mites and lice infestation were the dominant ones that cause of skin diseases 136 (88.8%) and 17(11.11) respectively. And also goats were highly affected 130 (84.9%) than sheep's 23(15.03) by mange mites. Concerning the age groups and seasonality variation, 123 (80.39%) respondents were also explained that adults more affected than young animals. 131(85.62%) of the respondent's agreed that the infestation highly aggravated during the dry or after the rainy season, whereas about 22 (14.3 %) of the respondents replied mange is problem during the wet season (Table 1).

Concerning the control programme, 149 (97.3%) respondents were participate on control program that lunched by government but the remains 4(2.61%) respondents were not involved in any programme (Table1).

In addition to that the respondents explained transmission of mange mite was mainly by direct contact of sinks those animals on beading, grazing and watering places.

The present study demonstrated that mange mites are one of the most important ectoparasites of small ruminants of all age groups, both sexes and body conditions in all agroecological zones of the study area. Mange mite infections had great enforcements to sale their live sheep and goats and also affect to sale their skins. These findings are in line with Kassa *et al.* (2012) who reported that 50% of processed skin rejection is caused by skin disease in Ethiopia. Akomas *et al*. (2011) reported that mange mites are the most notorious ectoparasites of small ruminants and are responsible for great economic losses especially in Africa, including Ethiopia.

On the present study, the only isolated mange mite species affecting both sheep and goats was *S. scabiei* from goats and sheep, respectively. This species was also identified in different agroecological areas in Ethiopia (Mulugeta *et al.*, 2010; Asnake *et al.*, 2013).

In the present study, the lesion caused by *S. scabiei* in goats was found to be distributed around the face, head, tail, neck and legs. The lesions in goats were characterized by loss of hair, ragged wool and crust formations in chronic cases ESGPIP (2009). The lesion of *S. scabiei* in sheep was observed mostly around the ear, face and head areas and nodule formation was the characteristics lesion recorded (Kettle, 1995).

The overall prevalence of *S. scabiei* in sheep and goats recorded in the present study was higher than the previous reports (Teshome *et al.*, 2002) with 2.1 % in sheep and 4.3 % in goats in Sidama zone, (Sertse and Wossene, 2007) 0.4 % in sheep and 6.6 % in goats in Amhara Regional State, (Yalew *et al*.,2007) 0 % in sheep and 0.98 % in goats in Wolayta Sodo and (Beyecha and Kumsa, 2014) 1.2 % in sheep and 8.8 % in goats in central Oromia. The possible reason for this differences in the prevalence among different studies could be variations in environmental and host factors, study seasons, owners knowledge on control practices of mites and animal husbandry and managements (Beyecha,2014). It also implies that the climatic conditions of the current study areas are more suitable for survival, reproduction and development of various stages of mites. The effect of ectoparasites can also be influenced by nutritional status of the host. Well-fed animals can survive the parasite infestation better than animals with nutritional deficiency.

In the present study, the highest prevalence of *S. scabiei* in shoats was observed in highland (40.24%) area followed by midland (24.74) and the lowest in lowland (20%) area. This finding disagreed with previous reports (Beyecha *et al.,* 2014). This difference in prevalence might be associated with difference in animal population which causes favorable condition for the transmission of mites between animals and results in high level of mite infestation (Sertse and Wossene, 2007). Therefore, incidence of mange mite is higher in wet, cold area (i.e., high temperature humidity and sun light in which moisture and temperature are optimum for reproduction, multiplication and mite development favoring its infestation (Olubummin *et al.*, 1995*).*

In this study, sex was not associated with prevalence of *S. scabiei* which was inagrement with the work of Desie *et al*. (2010) and Enquebaher and Etsay (2010). However, the prevalence was slightly higher in male than female goats in this study. This may be due to frequent contact of male goats at the time of mating and fighting.

The higher prevalence was observed in young animals than adult ones in the present study. This result agreed with the findings of Kasaye and Kebede (2010) and Shiferaw *et al.* (2010) who reported higher prevalence of *S. scabiei* in young animals than the old age group. It might be related to the degree of movement and frequent contacts of young animals with other flocks. Furthermore, age was reported to have no significant effect on the prevalence of mange mites (Yacob *et al*., 2008). Mange mite infestation is described to be independent of age and sex (Soulsby, 1998). Therefore, sex and age of the host animals are not contributing factors for the differences in the prevalence of mange in the study area.

In the current study, the highest level of prevalence was observed in animals with good body condition compared to the prevalence in poor body condition. The present study report disagreed with the findings of Tsrese and Wossene (2007) who reported that poor body conditioned goats were 4.3 times at risk for sarcoptic mange than good body conditioned goats. Poorly nourished animals appear to be less competent in getting rid of infestation as compared to that of well-managed animals (Tsrese and Wossene (2007).

Only agro-ecological variations was a factor yielded significant (P<0.0.31) association to the prevalence of *Sarcoptes scabiei* infestation among the study population. Shoats found in highland were 1.46 times more exposed to mange mite infestation than midland.

Sarcoptes scabiei infestation by agro-ecology revealed that there was significant association (p<0.031) between *Sarcoptes scabie* infestation and agro ecology. Those shoats found in midland were less likely affected (OR = 0.547) by the *S. scabiei* infestation when compared with those reared shoats in lowland area. This finding disagreed with those reports by Tefera (2004) and Pangui (1994). The high prevalence of the *S. scabiei* in the highland may be associated with the ideal micro climate environment in these areas which favors the breeding and multiplication of mange mite eggs to their developmental stages (Pangui, 1994).

6. CONCLUSION AND RECOMMENDATIONS

In general, this cross-sectional study of mange mites in sheep and goats revealed a prevalence of *S. scabiei* in the study area. Additionally, the high prevalence of *S. scabiei* in the present study had great enforcements for the farmers to sale their live sheep and goats and also affected the sales of skins of sheep and goats. Among the major risk factors, only agroecology was found to have significant affect the prevalence *S. scabiei*. But other factors like backward level of management, poor level of awareness of farmers and weak animal health extension services which were not under this investigation believed to have wide contribution for wide spread and occurrence of mange mites in the study area leading to important economic losses.

Based on the above conclusion the following recommendations are forwarded:

- Small ruminant management practices should be implemented to minimize transmission of the disease and increase the productivity of small ruminants.
- Strategic treatment of small ruminants with insecticides should be practiced in the study area to minimize the impact of mange mite on the health of animals.
- Appropriate extension programs should be launched to create public awareness about the economic importance, treatments and its impact on skin quality.

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8. ANNEXES

Annex 1. Questionnaire for sheep and goat owners.

Date _____ Zone _____Woreda_____ Kebele_____

Village Owner Name_____

1. Family income source (Rank)

Crop sale _____ Animal product sale_____

Animal sale _____ Others_____

2. Livestock ownership pattern (number of animals owned).

Sheep _____ Goat_____

Cattle _____ Equines_____

3. Why do you keep sheep and goats? (Rank)

For income generation and insurance _____ Skin production _____

Meat for home consumption _____ Milk for consumption others_____

4. Management type

- Mixed farming
- Pastoral

5. Which species are more important for this area?

o Sheep

o Goats

o Equally

Do you know any skin diseases that affect sheep and goats?

o Yes_____-

o No_____

8. If yes, can you mention them? –

–

_____

_____

_____

9. Which species are more commonly affected?

Disease	Sheep	Goats	Equally
Lice	_____	_____	_____
Ticks	_____	_____	_____
Keds	_____	_____	_____
Mange mite	_____	_____	_____

10 which age groups are more affected

Disease	Sheep			Goats		
	Lamb	young	Adult	Kid	young	Adult
o Lice	_____	_____	_____	____	_____	_____
o Ticks	_____	_____	_____	-_____	_____	_____
o Keds	_____	_____	_____	_____	_____	_____
o Mange mite	_____	_____	_____	_____	_____	_____

11. Is there seasonal variation in the occurrence of the diseases?

Diseases	Yes	No	I don't know
Lice	_____	_____	_____
Ticks	_____	_____	_____
Mange mite	_____	_____	_____

13. Which skin diseases have effect on sell of sheep and goats?

	Yes	No
• Lice	_____	_____

• Ticks _____ _____

• Mange Mite _____ _____

14. Do they have effect on the sale of skin?

	Yes	No
• Lice	_____	_____
• Keds	_____	_____
• Ticks	_____	_____
• Mange Mite	_____	_____

15. How do you treat skin diseased animals?

• Modern treatment

• Traditional treatment

16. Which skin diseases are treated traditionally?

_____

_____

17 What is the name of traditional remedy used? And its effect (recovery/ Partial recover

_____

_____

_____

Annex2- Animal skin scraping Sample Collection Format

ID	District	Kebele	Age	Sex	Animal species	Management system	Result	
							+ve	_ve
01								
384								